Libby Health Care Study Group

Medical Costs of Asbestos-Related Diseases

Cost Projection for the Five-Year Period 2005 - 2009

Submitted by
Insurance Services Office, Inc.
Actuarial Consulting Service
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April 14, 2005

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April 15, 2005

Dr. Robert Wynia, M.D.
Director of the Department of Health & Human Services
State of Montana
111 Sanders
Helena, MT 59624

Dear Dr. Wynia:

Enclosed you will find the report that projects the medical costs of asbestos-related diseases for the five year period 2005 to 2009. This final report is essentially the same as the draft report that was issued on January 31, 2005.

As you are aware, the draft report was prepared under the direction of James Buck over an approximate time period of two years. Mr. Buck ceased employment at Insurance Services Office, Inc. (ISO) on February 14, 2005. As a result, he is not available to issue the final version of the report.

Both Virginia Prevosto and Paul Ericksen have peer reviewed the draft report dated 1/31/05, and feel comfortable with the general approach that was used. Both Ms. Prevosto and Mr. Ericksen are fellows of the Casualty Actuarial Society and members of the American Academy of Actuaries. It should be noted that we were unable to verify all of the underlying assumptions due to the fact that we were not involved in the development of the draft report, nor were we present during the various teleconferences and phone conversations between Mr. Buck and the client.

We have reviewed a letter from Dr. J. Jay Flynn, dated 1/25/05, where Dr. Flynn identifies several issues that he believes will cause the projections of future asbestos-related medical costs based on Mr. Buck's methodology to be too high. Although we do not necessarily agree with all points raised by Dr. Flynn, he does raise some issues that may have some validity. In particular, he makes reference to an HNA database that was not used in Mr. Buck's analysis. At this late stage, it is beyond the scope of the original engagement to investigate the issues raised by Dr. Flynn. Should you wish that we investigate the various issues raised by Dr. Flynn, we would be happy to submit a proposal for the additional work.

We are pleased to have issued the final report, and are available to answer any questions you may have.

Sincerely,

Virginia Prevosto, FCAS, MAAA
Principal, Consulting

Paul Ericksen, FCAS, MAAA
Consulting Actuary

Andrew Yershov
Actuarial Associate

TABLE OF CONTENTS

INTRODUCTION

Insurance Services Office, Inc. ("ISO") has prepared a cost estimation study for the medical expenses of treating asbestos-related diseases for the population in and around the city of Libby, Montana. The people of Libby were exposed to asbestos from the vermiculite mine and mill that operated near the city through 1990. The population around Libby that has been exposed to asbestos has been screened by the Agency for Toxic Substances and Disease Registry ("ATSDR"), a public health agency of the U.S. Department of Health and Human Services.

The mine was operated from1963 on by W.R Grace & Co.("Grace"). Grace has offered a health insurance program to Libby residents that pays for screening and treatment of asbestos-related diseases ("ARD"). The program is administered by Health Network America ("HNA"). The total cost of the medical treatment of ARD for the population of Libby in the next five years would consist of the expenses incurred for people participating in the HNA program as well as costs incurred and paid outside of the HNA program.

OBJECTIVE

The objective of our study is to: estimate the cost of medical expenses that are necessary for treatment of ARD for the population of Libby for the next five years (2005 – 2009).

This report responds to this objective.

LIMITATIONS

The results of our study are based on the information provided by the following parties: HNA, St. John's Lutheran Hospital of Libby, Montana ("SJLH"), the Clinic for Asbestos Related Disease ("CARD Clinic") of Libby, Montana and the ATSDR. This information included

- Medical costs data for treatments of ARD that were paid through the HNA program in 2000 to 2004, although the data for calendar years 2000 and 2004 covered only a partial-year period. This data had cost information along with the diagnostic codes and procedure codes related to the administered treatments. However, this data covered only the records of 855 patients, which is a fraction of the total Libby population that has a potential to develop an ARD.

- Exposure database from the ATSDR. It contained detailed information on exposure to asbestos, other lifestyle characteristics that correlate with lung diseases (e.g., smoking) and medical testing data that indicated changes in lung tissue or function. This database had 7,307

records and covered a large proportion of the overall population of Libby that might be affected by ARD.

- SJLH and CARD clinic records, for a sample of the population. This data provided the information on about roughly 5,000 hospital visits during the last few years. This data was primarily used to gauge the percentage of the hospital charges that were paid by the HNA program.

In preparing our report, we have relied upon the information provided in the datasets mentioned above. We have reviewed the data for reasonability, but have not audited the data. Any material error in the data or other information provided to us could substantially affect our estimates. In such event, ISO cannot be responsible for any consequences resulting from its use of incorrect information or data in forming its opinions or making its recommendations.

By their nature, insurance claims are subject to variability. The ultimate liabilities and claim costs depend on the outcome of future contingent events, the result of which cannot be known in advance. Future emergence of medical costs and expenses may differ substantially from our estimates.

The datasets provided to us were of varying quality. The HNA data had valid SSNs without missing values, the paid data was presumed valid (insurance payments are generally audited), but the diagnostic codes (up to five per record) might be less valid, but still allowed us to categorize degrees of illness as a predictor of costs. The ATSDR database had some Social Security Numbers missing or invalid, had some other anomalies like negative values for packs of cigarettes smoked or a Body Mass Index ("BMI ") of 0, and, in general, not all values were filled in for all fields. However, if the errors are random, the ATSDR database can still be a useful tool to do statistical analyses.

Due to these characteristics of the provided data, a reasonable estimate can be made about the future medical costs of treatments of ARD provided through the HNA program, at least based on certain assumptions. However, the proportion of total Libby ARD expenses funded by the HNA program is best measured by the proportion of SJLH and CARD Clinic charges paid by HNA, and that information was not provided to us. We have suggested that the additional information be collected by SJLH and the CARD Clinic to better estimate this proportion. The uncertainty of our projections for the total Libby costs is increased by the presence of this uncertainty about the share of the HNA program to the total Libby ARD costs.

This report is for the use of the Libby Health Care Study Group participants. There is no representation that this is a prescribed statement of actuarial opinion. Any other use or disclosure is prohibited unless consented to in writing by

INTRODUCTION

Insurance Services Office, Inc. If Insurance Services Office, Inc. consents to this report being distributed further, the report must be distributed in its entirety. The actuary signing this report is available to answer questions about it.

SECTION 2

EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

The key results of our analysis are summarized below. Supporting documentation, background information and the details of our analysis can be found in the later sections of this report, including the Exhibits and Appendix.

1. **Medical Cost Estimates for HNA Program for the Years 2005 - 2009.** The chart below summarizes our estimates of the total Libby medical costs for treatments of Asbestos Related Disease (ARD) under the HNA program. This is a projection of cost increases in the program, at rates similar to medical care inflation, based on the history of the HNA program costs. An implicit assumption of the projection is that the current program pays for reasonable ARD costs. To the extent that non-ARD costs are paid for in the program, the estimate of the true cost of ARD would be overstated, while to the extent costs are missing, or not reimbursed by the program, costs would be understated.

LIBBY HEALTH CARE STUDY GROUP
ESTIMATED HNA COSTS FOR 2005-2009
($ IN MILLIONS)

Year	Cost
2005	$1.7
2006	1.9
2007	2.1
2008	2.3
2009	2.5
Total	**$10.5**

2. **Medical Cost Estimates for Total Libby ARD Costs for the Years 2005 – 2009.** ISO attempted to project the total costs for Asbestos-Related Diseases for the total Libby population. The best way to extrapolate the expenses from the HNA program to all Libby ARD costs would be to sample the records of St. John's Lutheran Hospital and the CARD Clinic to determine the share of expenses that HNA is currently paying of ARD expenses. Absent that information, we have tried to show a range in which the costs of ARD are likely to fall. The first two estimates show the low, which assumes all costs are covered by HNA, and an estimate of 80% coverage by HNA, based on the impressions of Montana DPHHS staff. The third estimate is based on the proportion of screened-positive ATSDR cases, while the high

estimate is based on assuming the ATSDR population will have the same health costs as the HNA population, a very worst-case scenario.

LIBBY HEALTH CARE STUDY GROUP
ESTIMATED TOTAL ARD COSTS FOR 2005-2009
USING VARIOUS ESTIMATES OF HNA'S SHARE OF TOTAL COSTS
($ IN MILLIONS)

	Scenario			
	Low	**Medium-1**	**Medium-2**	**High**
HNA Cost	$10.5	$10.5	$10.5	$10.5
HNA as Percent of Total	100%	80%	33%	12%
Total ARD Cost	**$10.5**	**$13.2**	**$32.2**	**$90.1**

3. **Medical Cost Estimates of Average Annual Cost of Libby ARD in the years 2005-2009**. The costs shown in 2. above are for a five year period. In the chart below, we express them as an average annual value, since budgeting is often done on an annual basis.

LIBBY HEALTH CARE STUDY GROUP
AVERAGE ANNUAL ARD COSTS FOR 2005-2009
USING VARIOUS ESTIMATES OF HNA'S SHARE OF TOTAL COSTS
($ IN MILLIONS)

	Scenario			
	Low	**Medium-1**	**Medium-2**	**High**
HNA Cost	$2.1	$2.1	$2.1	$2.1
HNA as Percent of Total	100%	80%	33%	12%
Total ARD Cost	**$2.1**	**$2.6**	**$6.4**	**$18.0**

SECTION 3

LOSS PROJECTION BASIS

LOSS PROJECTION BASIS

Our study and analyses were based on the following characteristics of Libby ARD:

1. The insurance program providing ARD coverage to Libby residents funded by W.R. Grace & Company and administered by HNA.

2. The screening and other lifestyle information on Libby area residents compiled as part of the ATSDR study and its updates.

3. A set of actuarial assumptions and statistical methods.

These elements are discussed in this section.

COVERAGE PROVIDED BY THE PROGRAM

The following is a description of several aspects of the insurance coverage provided under the HNA Program. The program is intended for Libby area residents who have not sued W.R. Grace, and is intended to cover all asbestos-related screening and treatment. In the beginning, it was administered liberally, with coverage provided for a number of lung-related treatments not directly related to asbestos (such as asthma treatments), according to HNA staff. The reimbursement approach has been tightened over time, a statement that is confirmed by provider comments. According to HNA, the peak year for payments was 2002, with payments for later years declining from that level.

We have chosen to project based on treatment year, rather than payment year. This provides an upward projection of costs, consistent with healthcare cost and utilization trends. In other words, while a tightening of the reimbursement criteria can yield reductions in costs in the short run, cost and utilization trends will tend to cause health care costs to increase in the longer run.

We also observe that while providers suggest that the reimbursement of costs by the HNA program are at substandard levels, we found no evidence of this in our inspection of the charges and reimbursements. Overall, the reimbursement by HNA was 92% of the hospital charges, a level significantly higher than for government payers (Medicare, Medicaid).

ASBESTOS EXPOSURE AND LIFESTYLE DATA

The historical asbestos and lifestyle information was provided to us by ATSDR for the purposes of our study. Working with ATSDR and Montana DPHHS personnel, we determined a list of appropriate variables to predict the incidence of positive status, or evidence of changes in health

LOSS PROJECTION BASIS

ACTUARIAL ASSUMPTIONS

Comments on some of the key actuarial assumptions used in our study are described below:

EXPERIENCE

For estimating medical costs of diagnostics and treatments provided through the HNA program, we have taken a five-year experience period — from 2000 to 2004 — although only three years (2001, 2002, 2003) had a volume of data that covered the full one-year period. We have not made explicit use of any external loss experience in making the cost projection.

TRENDS

We have not projected HNA medical costs to change from historical levels through the use of trend factors. Instead, we extrapolated the pattern that underlies the HNA historical data (aggregated by the treatment year) for the two most credible years of experience (2002, 2003). This increasing pattern seems to be consistent with general trends in medical costs and utilization, and should capture changes in inflation, utilization and numbers of people affected, albeit grossly.

PAYOUT PATTERNS AND TIME VALUE OF MONEY

We have not provided an analysis of the discounted value of the healthcare costs for Libby ARD, since this was not requested. It should be noted that the future costs projected here produce a conservative estimate of the present value of the liabilities, with an implicit margin of approximately 10 to 30 percent of the loss estimates, depending on the interest rate chosen. The present value is the amount of money that would need to be put aside today to fund the future costs of Libby ARD.

SECTION 4

LOSS PROJECTION RESULTS

LOSS PROJECTION RESULTS

DERIVATION OF PROJECTED 5-YEAR HNA COSTS

On Exhibit 1, we show the actual and projected costs of diagnosing and treating ARD under the HNA program. Column (1) shows the historical HNA costs aggregated by a treatment year (more precisely, by a year when a treatment started). Costs for years 2000 and 2004 represent periods of less than one year, therefore only years 2001, 2002 and 2003 provide credible full-year data points. Column (2) shows the average annual growth factor based on HNA costs in those three years. Column (3) shows the average annual growth factor based only on HNA costs in years 2002 and 2003, the years that, according to HNA, saw the highest utilization of services under the program. The selected cost growth factor in Column (4) was chosen equal to the one in Column (3). The cost estimates in Column (5) were then computed by applying the selected growth factor to the latest available full-year HNA historical cost (which would be the year 2003 data point). For example, the $1,897,204 estimate of HNA costs for treatments that would start in 2006 is equal to the year 2003 costs ($1,422,173) times the selected factor (1.101) raised to the power of three (the difference, in years, between years 2006 and 2003). The total cost in Column (5) -- $10,539,120 -- is the sum of projected HNA costs for treatment years 2005 through 2009.

ANALYSIS OF HISTORICAL HNA COSTS BY CATEGORY

In order to better understand the incidence and relative severity of the underlying HNA costs, we attempted to analyze them by category. One category is the seriousness of a treated ARD, which can be ascertained from the diagnostics data embedded in the HNA dataset. Since many of the HNA patients were also screened by ATSDR, the other chosen category was the overall ATSDR assessment of that patient's screening – positive or negative.

A person in the HNA dataset was considered in the "Serious" category if one of the following two conditions were met:

- Any of the provided diagnostic codes indicated a malignant neoplasm of respiratory and intrathoracic organs (ICD-9 codes 160, 161, 162, 163, 164 and 165). Those cases were then checked by Dr. Michael Spence of the Montana Department of Public Health and Human Services. Out of 13 checked cases, 6 were confirmed as either a Lung Cancer or Mesothelioma, and the remaining 7 cases were either confirmed as non-asbestos-related cancers or not found in the ATSDR tumor registry. There did not appear to be a significant difference in the cost level between cases with a Lung Cancer and cases with a non-asbestos-

related cancer, and we classified all 13 flagged cases in the "Serious" category. Of course, to the extent these payments shouldn't have been made as part of the program, the overall cost of ARD is overstated.

- Alternatively, if for a given person
  - Any of the provided diagnostic codes indicated Asbestosis (ICD-9 code 501), and
  - The associated procedure codes were E0431, E0434, E0439, E0442, E0443, E0444 or E1390 (those HCPCS codes corresponding to procedures that involve administration of oxygen), and
  - The total cost of procedures in the above list exceeded $1,000 in any calendar year (2000 through 2004),

  then we would also classify this person in the "Serious" category.

A person in the HNA dataset was considered in the "Asbestosis" category if that person did not have a malignant neoplasm of respiratory and intrathoracic organs, if any of the provided diagnostic codes indicated Asbestosis (ICD-9 code 501), and the associated procedure codes were either not oxygen-related, or the annual cost of oxygen-related procedures did not exceed $1,000 in all calendar years. Again, to the extent the data is inaccurate, our cost estimates would change.

The remaining patients in the HNA dataset who were not classified in either "Serious" or "Asbestosis" category were classified in the "Other" category.

The lower part of Exhibit 2 shows the breakdown of the HNA total costs (Column (1)) and the number of people treated under the HNA program (Column (2)) by these "degree of illness" categories. The upper part shows the same information but broken down by the ATSDR screening status – positive or negative. This summary was done by merging the HNA dataset with the ATSDR dataset. 145 of HNA patients were not matched in the ATSDR dataset and are listed in the summary under the "Unknown" category.

DERIVATION OF ESTIMATED 5-YEAR TOTAL COSTS

Now, with the projected 5-year HNA costs estimated at $10.5 Million, we estimate the total costs of the future ARD treatments in 2005 – 2009 (through HNA and outside of HNA). The key assumption here is the estimated HNA share of the total treatable population of Libby.

LOSS PROJECTION RESULTS

Exhibit 3 shows the calculation of the estimated total costs. Row (1) shows the HNA 5-year projected costs, Row (6) shows the assumed proportion of the HNA data to the total data, and the estimate of the total costs in Row (7) is calculated as a ratio of Row (1) over Row (6).

In the first two scenarios ("Low" and "Medium-1"), the HNA share in Row (6) was selected judgmentally. The first is the lower bound – it assumes no one other than HNA insureds has ARD. The second represents our understanding of the judgment of Dr. Michael Spence of the Montana DPHHS, based on his knowledge of Libby, as expressed in a teleconference. In the third scenario ("Medium-2"), the HNA ratio in Row (6) is approximated by the fraction of the ATSDR screened-positive population that had a matching record in the HNA dataset – in other words, if HNA insureds represent a third of the total population that has screened positive, they also represent a third of total ARD costs. The fourth scenario ("High") assumes that the entire population screened by ATSDR (7307 people) has costs equal to HNA insureds, which serves as an upper bound to the costs, in our opinion, based on the data and assumptions.

RESULTS OF THE MODEL THAT ESTIMATES THE PROBABILITY OF BEING SCREENED POSITIVE BASED ON SELECT VARIABLES FROM THE ATSDR DATASET

Exhibit 4 shows the results of the model that predicts the probability of ATSDR status positive based on the individual characteristics of a person. The model was built by using the SAS statistical software. Excerpts of the SAS output are included in the Appendix.

This exhibit is for information only. This analysis was not used in the calculation of the projections of future medical costs.

DESCRIPTION OF THE MODEL

When screening the population of 7307 Libby residents for ARD, ATSDR collected a multitude of information about personal characteristics, lifestyle characteristics and medical characteristics of that population. These characteristics, along with the final ATSDR screening assessment (Positive or Negative) were provided to us in a data file ("ATSDR dataset").

During discussions with participants in the Libby Health Care Study Group, the multitude of ATSDR variables was pared down to the set of variables that were

deemed the most important in predicting the final status of an ATSDR screening. The variables selected based on these discussions are:

- The age of a person (model variable "age" = ATSDR variable "AGE")
- The sex of a person (model variable "subsex" = ATSDR variable "SUBSEX")
- Whether a person had major exposure to asbestos (model variable "exposed").
  A person was considered to have major exposure to asbestos if that person either ever worked at the W.R. Grace vermiculite mine or mill (ATSDR variable "WORKWR" = 1) or ever worked as a secondary contractor at the W.R. Grace vermiculite mine or mill (ATSDR variable "WORK2ND" = 1) or ever lived in the same household with a person who worked at the W.R. Grace vermiculite mine or mill (ATSDR variable "HHWR" = 1). All other people were considered not to have major exposure to asbestos.
- The smoking status of a person (model variable "nsmoke" = ATSDR variable "NSMOKE"), differentiating people who never smoked from people who ever smoked.
- The number of cigarettes smoked by a person per lifetime (model variable "pkyears" = ATSDR variable "PKYEARS").
- The Body Mass Index (BMI) of a person (model variable "bmi" = ATSDR variable "BMI")
- The number of different ways a person was exposed to asbestos (model variable "pathway" = ATSDR variable "PATHWAY").
- The final status of an ATSDR screening of a person (model variable "FinalStatus" = ATSDR variable "FINALSTATUS"), differentiating people with Positive and Negative screening results.

At first, a few simple statistics and correlation coefficients were computed for the selected variables. The results are shown on Page 1 of the Appendix. For example, the average age of the ATSDR population was about 51 years, and the average BMI of about 28. The highest correlation coefficient was observed between nsmoke and pkyears (58%), which is not surprising since pkyears must be equal to 0 for people who never smoked.

The goal of the model was to estimate the probability of screening result being positive (Final Status = P) based on the values of the other selected variables.

PARAMETERS OF THE MODEL WITHOUT INTERACTIONS

LOSS PROJECTION RESULTS

The predictive model we illustrate on Exhibit 4 is a linear logistic regression model without interactions. The parameters of the model were estimated using the SAS "LOGISTIC" procedure. The results are shown on Pages 2-5 of the Appendix, with the parameter estimates listed on Page 4.

The variable nsmoke was found insignificant (due to the fact that it is contained, in essence, in another variable, pkyears) and was removed from the list of variables used in the model.

If P denotes the probability of {FinalStatus = Positive}, then the model equations become

A = LOG [(1-P) / P] = 7.8789 - 0.4764 x [subsex] - 0.0667 x [age] + 0.3284 x [exposed] - 0.0729 x [pathway] - 0.00003 x [pkyears] - 0.0807 x [bmi],

P = 1 / (1 + EXP(A))

Here,

- subsex = +1 for Male, -1 for Female
- exposed = +1 for people without major exposure, -1 for people with major exposure to asbestos.

A quick look at these equations suggests that P, which moves in a different direction with A, increases for Males vs Females, increases with age, increases for people with major exposure to asbestos, and increases when either of the other variables (pathway, pkyears, bmi) increases.

The numerical results, showing changes in P when one of the characteristics of a person is changed while all the other characteristics are left unchanged, are shown on Exhibit 4. The biggest jump in P is observed when the variable subsex is changed from Female to Male (6.22% vs 14.68%) and when the variable exposed is changed (6.22% without major exposure vs 11.35% with major exposure to asbestos).

PARAMETERS OF THE MODEL WITH INTERACTIONS

Another model was also fit, namely a linear logistic regression model with interactions. At first, interactions between all the selected variables were entered,

and then only statistically significant interactions were kept by backward elimination or stepwise inclusion methods.

Both methods (backward elimination and stepwise inclusion) returned the same set of significant predictors – only 3 interactions remained in the model, namely

age * exposed
pathway * exposed
bmi * subsex

The others were found not statistically significant. For example, since age*subsex interaction was found insignificant and removed from the model, it means that age affects the probability of {FinalStatus = Positive} in the same way for Males and for Females.

The parameters of the model were again estimated using the SAS "LOGISTIC" procedure. The results are shown on Pages 6-21 of the Appendix, with the parameter estimates listed on Page 22.

The model equation becomes

A = LOG [(1-P) / P] = 8.23443 + 0.17625 x [subsex] - 0.06891 x [age] - 0.29588 x [exposed] - 0.0826 x [pathway] - 0.00002722 x [pkyears] - 0.08526 x [bmi] + 0.00605 x [age*exposed] + 0.04489 x [pathway*exposed] – 0.02206 x [bmi*subsex]

This model exhibits the same qualitative characteristics as the model without interactions, but it is a little less transparent. For example, even though the coefficient corresponding to the variable subsex changed sign and became positive (+0.17625), it is balanced by the negative coefficient corresponding to the [bmi*subsex] predictor, and for a reasonable range of the variable bmi (bmi > 8) the overall coefficient corresponding to the subsex variable becomes negative, as in the model without interactions.

SECTION 5

EXHIBITS

MONTANA DEPARTMENT OF PUBLIC HEALTH & HUMAN SERVICES
LIBBY HEALTH CARE STUDY GROUP

HISTORICAL AND PROJECTED ANNUAL COSTS OF THE HNA PROGRAM

Calendar Year	(1) Historical Paid Costs	(2) 2001-2003 Growth Factor	(3) 2002-2003 Growth Factor	(4) Selected Growth Factor	(5) Projected Paid Costs
2000	296,576				
2001	970,102				
2002	1,291,909				
2003	1,422,173	1.211	1.101	1.101	
2004	124,324				
TOTAL (2000-2004)	4,105,084				
2005					1,723,429
2006					1,897,204
2007					2,088,500
2008					2,299,085
2009					2,530,903
TOTAL (2005-2009)					10,539,120

Notes

(1) Summarized costs by calendar year, based on service date from data provided by HNA.
(2) Average annual growth based on three points (2001, 2002, 2003).
(3) Average annual growth based on two points (2002, 2003).
(4) Selected annual increase in costs based on (3).
(5) 2003 value, trended forward with the trend factor in (4).

MONTANA DEPARTMENT OF PUBLIC HEALTH & HUMAN SERVICES
LIBBY HEALTH CARE STUDY GROUP

CHARACTERISTICS OF HNA COSTS BY ATSDR STATUS AND DIAGNOSIS

Characteristics	(1) Historical Paid Costs	(2) Number of People	(3) Historical Average Costs
ATSDR STATUS			
POSITIVE	2,267,213	517	4,385
NEGATIVE	794,069	193	4,114
UNKNOWN	1,043,802	145	7,199
TOTAL	4,105,084	855	4,801
DIAGNOSIS			
SERIOUS	1,998,601	77	25,956
ASBESTOSIS	1,689,784	508	3,326
OTHER	416,699	270	1,543
TOTAL	4,105,084	855	4,801

Notes

(1), (2) *Based on data provided by HNA for the whole period (2000-2004).*

(3) *= (1) / (2)*

MONTANA DEPARTMENT OF PUBLIC HEALTH & HUMAN SERVICES
LIBBY HEALTH CARE STUDY GROUP

PROJECTION OF 2005-2009 TOTAL COSTS

	Category / Projection	Low	Medium-1	Medium-2	High
(1)	HNA Projected Paid Costs (2005-2009)	10,539,120	10,539,120	10,539,120	10,539,120
(2)	HNA Number of People with ATSDR Status Positive			517	
(3)	HNA Total Number of People				855
(4)	ATSDR Number of People with ATSDR Status Positive			1,578	
(5)	ATSDR Total Number of People				7,307
(6)	Estimated HNA Share of the Total Treatable Population	100%	80%	33%	12%
(7)	Total Projected Paid Costs (2005-2009)	10,539,120	13,173,900	32,167,759	90,069,416

Notes

(1) *From Exhibit 1.*

(2), (3) *Based on data provided by HNA for the whole period (2000-2004).*

(4), (5) *Based on data provided by ATSDR.*

(6) *For Low and Medium-1 estimates - selected judgmentally.*
For Medium-2 estimate = (2) / (4).
For High estimate = (3) / (5).

(7) *= (1) / (6).*

MONTANA DEPARTMENT OF PUBLIC HEALTH & HUMAN SERVICES
LIBBY HEALTH CARE STUDY GROUP

EXAMPLE OF ESTIMATING THE PROBABILITY OF ATSDR STATUS POSITIVE BASED ON THE INDIVIDUAL CHARACTERISTICS OF A PERSON

Characteristics	Base Scenario	Scenario Base	Scenario Age=53	Scenario Male	Scenario Exposure	Scenario Pathways	Scenario Smoker	Scenario BMI=31	Description
SEX	FEMALE	-1	-1	1	-1	-1	-1	-1	1 for M, -1 for F
AGE	50	50	53	50	50	50	50	50	
MAJOR EXPOSURE	NO	1	1	1	-1	1	1	1	1 for NO, -1 for YES
# OF PATHWAYS	3	3	3	3	3	4	3	3	
# OF PACKS SMOKED	NONSMOKER	0	0	0	0	0	4,000	0	Per lifetime.
BMI	29.954	29.954	29.954	29.954	29.954	29.954	29.954	31.000	Body Mass Index
LOG [(1-P) / P]		2.712719	2.512619	1.759919	2.055919	2.639819	2.592719	2.628300	
Probability of ATSDR STATUS POSITIVE		6.22%	7.50%	14.68%	11.35%	6.66%	6.96%	6.73%	

Notes

The linear logistic regression model is based on the ATSDR data.
If P = Probability of ATSDR Status Positive, then
A = LOG [(1-P) / P] = 7.8789 - 0.4764 x [SEX] - 0.0667 x [AGE] + 0.3284 x [EXPOSURE] - 0.0729 x [PATHWAYS] - 0.00003 x [PACKS] - 0.0807 x [BMI]
P = 1 / (1 + EXP(A))

SECTION 6

APPENDIX

STATISTICAL ANALYSIS OF ATSDR DATA

The CORR Procedure

8 Variables: age subsex exposed nsmoke pkyears bmi pathway FinalStatus

Simple Statistics

Variable	N	Mean	Std Dev	Sum	Minimum	Maximum
age	7307	50.92377	17.55399	372100	14.00000	98.00000
subsex	7307	1.50718	0.49998	11013	1.00000	2.00000
exposed	7307	0.27658	0.44734	2021	0	1.00000
nsmoke	7306	1.50383	0.50002	10987	1.00000	2.00000
pkyears	7307	4037	6874	29495478	-7118	73000
bmi	7278	27.91231	6.22232	203146	0	61.67369
pathway	7307	4.93404	2.69775	36053	0	16.00000
FinalStatus	7268	0.21643	0.41184	1573	0	1.00000

Pearson Correlation Coefficients
Prob > |r| under H0: Rho=0
Number of Observations

	age	subsex	exposed	nsmoke	pkyears	bmi	pathway	Final Status
age	1.00000	-0.02190	0.15084	0.26567	0.37328	0.23448	0.08969	0.37966
		0.0612	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001
	7307	7307	7307	7306	7307	7278	7307	7268
subsex	-0.02190	1.00000	-0.08508	-0.10387	-0.10867	-0.01023	-0.26135	-0.18809
	0.0612		<.0001	<.0001	<.0001	0.3826	<.0001	<.0001
	7307	7307	7307	7306	7307	7278	7307	7268
exposed	0.15084	-0.08508	1.00000	0.11062	0.08808	0.06913	0.38532	0.19438
	<.0001	<.0001		<.0001	<.0001	<.0001	<.0001	<.0001
	7307	7307	7307	7306	7307	7278	7307	7268
nsmoke	0.26567	-0.10387	0.11062	1.00000	0.58283	0.06971	0.15472	0.16906
	<.0001	<.0001	<.0001		<.0001	<.0001	<.0001	<.0001
	7306	7306	7306	7306	7306	7277	7306	7268
pkyears	0.37328	-0.10867	0.08808	0.58283	1.00000	0.04359	0.09141	0.23605
	<.0001	<.0001	<.0001	<.0001		0.0002	<.0001	<.0001
	7307	7307	7307	7306	7307	7278	7307	7268
bmi	0.23448	-0.01023	0.06913	0.06971	0.04359	1.00000	0.14994	0.20849
	<.0001	0.3826	<.0001	<.0001	0.0002		<.0001	<.0001
	7278	7278	7278	7277	7278	7278	7278	7239
pathway	0.08969	-0.26135	0.38532	0.15472	0.09141	0.14994	1.00000	0.15863
	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001		<.0001
	7307	7307	7307	7306	7307	7278	7307	7268
FinalStatus	0.37966	-0.18809	0.19438	0.16906	0.23605	0.20849	0.15863	1.00000
	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	
	7268	7268	7268	7268	7268	7239	7268	7268

The LOGISTIC Procedure

Model Information

Data Set	WORK.C
Response Variable	FinalStatus
Number of Response Levels	2
Number of Observations	7239
Link Function	Logit
Optimization Technique	Fisher's scoring

Response Profile

Ordered Value	Final Status	Total Frequency
1	0	5676
2	1	1563

NOTE: 68 observations were deleted due to missing values for the response or explanatory variables.

Backward Elimination Procedure

Class Level Information

Class	Value	Design Variables
subsex	1	1
	2	-1
exposed	0	1
	1	-1
nsmoke	1	1
	2	-1

Step 0. The following effects were entered:

Intercept age subsex exposed nsmoke pkyears bmi pathway

Model Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

The LOGISTIC Procedure

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	7554.989	5704.328
SC	7561.876	5759.426
-2 Log L	7552.989	5688.328

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	1864.6612	7	<.0001
Score	1542.5116	7	<.0001
Wald	1151.3115	7	<.0001

Step 1. Effect nsmoke is removed:

Model Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	7554.989	5703.405
SC	7561.876	5751.615
-2 Log L	7552.989	5689.405

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	1863.5845	6	<.0001
Score	1542.3404	6	<.0001
Wald	1150.9579	6	<.0001

Residual Chi-Square Test

Chi-Square	DF	Pr > ChiSq
1.0786	1	0.2990

NOTE: No (additional) effects met the 0.05 significance level for removal from the model.

The LOGISTIC Procedure

Summary of Backward Elimination

Step	Effect Removed	DF	Number In	Wald Chi-Square	Pr > ChiSq
1	nsmoke	1	6	1.0778	0.2992

Type III Analysis of Effects

Effect	DF	Wald Chi-Square	Pr > ChiSq
age	1	644.9465	<.0001
subsex	1	179.2374	<.0001
exposed	1	79.6417	<.0001
pkyears	1	37.8495	<.0001
bmi	1	201.6785	<.0001
pathway	1	27.9229	<.0001

Analysis of Maximum Likelihood Estimates

Parameter		DF	Estimate	Standard Error	Chi-Square	Pr > ChiSq
Intercept		1	7.8789	0.2603	916.4344	<.0001
age		1	-0.0667	0.00263	644.9465	<.0001
subsex	1	1	-0.4764	0.0356	179.2374	<.0001
exposed	0	1	0.3284	0.0368	79.6417	<.0001
pkyears		1	-0.00003	4.355E-6	37.8495	<.0001
bmi		1	-0.0807	0.00569	201.6785	<.0001
pathway		1	-0.0729	0.0138	27.9229	<.0001

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
age	0.935	0.931	0.940
subsex 1 vs 2	0.386	0.335	0.443
exposed 0 vs 1	1.929	1.670	2.228
pkyears	1.000	1.000	1.000
bmi	0.922	0.912	0.933
pathway	0.930	0.905	0.955

Association of Predicted Probabilities and Observed Responses

Percent Concordant	83.1	Somers' D	0.665
Percent Discordant	16.7	Gamma	0.666
Percent Tied	0.2	Tau-a	0.225
Pairs	8871588	c	0.832

The LOGISTIC Procedure

Partition for the Hosmer and Lemeshow Test

		FinalStatus = 0		FinalStatus = 1	
Group	Total	Observed	Expected	Observed	Expected
1	724	240	235.43	484	488.57
2	724	387	391.59	337	332.41
3	724	469	482.82	255	241.18
4	724	545	550.16	179	173.84
5	723	602	598.89	121	124.11
6	724	643	636.33	81	87.67
7	725	674	666.67	51	58.33
8	723	697	687.93	26	35.07
9	724	711	707.14	13	16.86
10	724	708	718.79	16	5.21

Hosmer and Lemeshow Goodness-of-Fit Test

Chi-Square	DF	Pr > ChiSq
29.1613	8	0.0003

The LOGISTIC Procedure

Model Information

Data Set	WORK.C
Response Variable	FinalStatus
Number of Response Levels	2
Number of Observations	7239
Link Function	Logit
Optimization Technique	Fisher's scoring

Response Profile

Ordered Value	Final Status	Total Frequency
1	0	5676
2	1	1563

NOTE: 68 observations were deleted due to missing values for the response or explanatory variables.

Backward Elimination Procedure

Class Level Information

Class	Value	Design Variables
subsex	1	1
	2	-1
exposed	0	1
	1	-1

Step 0. The following effects were entered:

Intercept subsex exposed subsex*exposed age pkyears bmi pathway age*subsex age*exposed pkyears*subsex pkyears*exposed pathway*subsex pathway*exposed bmi*subsex bmi*exposed

Model Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

The LOGISTIC Procedure

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	7554.989	5689.852
SC	7561.876	5800.048
-2 Log L	7552.989	5657.852

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	1895.1372	15	<.0001
Score	1715.9649	15	<.0001
Wald	1168.1270	15	<.0001

Step 1. Effect pkyears*exposed is removed:

Model Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	7554.989	5687.852
SC	7561.876	5791.161
-2 Log L	7552.989	5657.852

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	1895.1370	14	<.0001
Score	1715.9616	14	<.0001
Wald	1168.1367	14	<.0001

Residual Chi-Square Test

Chi-Square	DF	Pr > ChiSq
0.0002	1	0.9875

Step 2. Effect subsex*exposed is removed:

The LOGISTIC Procedure

Model Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	7554.989	5685.968
SC	7561.876	5782.389
-2 Log L	7552.989	5657.968

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	1895.0213	13	<.0001
Score	1715.8288	13	<.0001
Wald	1168.4488	13	<.0001

Residual Chi-Square Test

Chi-Square	DF	Pr > ChiSq
0.1160	2	0.9437

Step 3. Effect pathway*subsex is removed:

Model Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	7554.989	5684.560
SC	7561.876	5774.094
-2 Log L	7552.989	5658.560

The LOGISTIC Procedure

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	1894.4288	12	<.0001
Score	1715.8288	12	<.0001
Wald	1169.3726	12	<.0001

Residual Chi-Square Test

Chi-Square	DF	Pr > ChiSq
0.7095	3	0.8710

Step 4. Effect pkyears*subsex is removed:

Model Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	7554.989	5683.429
SC	7561.876	5766.076
-2 Log L	7552.989	5659.429

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	1893.5598	11	<.0001
Score	1715.1963	11	<.0001
Wald	1170.4230	11	<.0001

Residual Chi-Square Test

Chi-Square	DF	Pr > ChiSq
1.5784	4	0.8127

Step 5. Effect bmi*exposed is removed:

The LOGISTIC Procedure

Model Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	7554.989	5682.366
SC	7561.876	5758.125
-2 Log L	7552.989	5660.366

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	1892.6235	10	<.0001
Score	1713.2280	10	<.0001
Wald	1172.0277	10	<.0001

Residual Chi-Square Test

Chi-Square	DF	Pr > ChiSq
2.5184	5	0.7737

Step 6. Effect age*subsex is removed:

Model Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	7554.989	5682.239
SC	7561.876	5751.112
-2 Log L	7552.989	5662.239

The LOGISTIC Procedure

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	1890.7497	9	<.0001
Score	1691.9826	9	<.0001
Wald	1181.3064	9	<.0001

Residual Chi-Square Test

Chi-Square	DF	Pr > ChiSq
4.3537	6	0.6289

NOTE: No (additional) effects met the 0.05 significance level for removal from the model.

Summary of Backward Elimination

Step	Effect Removed	DF	Number In	Wald Chi-Square	Pr > ChiSq
1	pkyears*exposed	1	14	0.0002	0.9875
2	subsex*exposed	1	13	0.1157	0.7337
3	pathway*subsex	1	12	0.5926	0.4414
4	pkyears*subsex	1	11	0.8700	0.3509
5	bmi*exposed	1	10	0.9372	0.3330
6	age*subsex	1	9	1.8640	0.1722

Type III Analysis of Effects

Effect	DF	Wald Chi-Square	Pr > ChiSq
subsex	1	1.0096	0.3150
exposed	1	2.0772	0.1495
age	1	584.3494	<.0001
pkyears	1	38.6747	<.0001
bmi	1	213.2110	<.0001
pathway	1	33.3800	<.0001
age*exposed	1	4.8096	0.0283
pathway*exposed	1	10.2657	0.0014
bmi*subsex	1	14.6026	0.0001

The LOGISTIC Procedure

Analysis of Maximum Likelihood Estimates

Parameter		DF	Estimate	Standard Error	Chi-Square	Pr > ChiSq
Intercept		1	8.2344	0.2789	871.9122	<.0001
subsex	1	1	0.1763	0.1754	1.0096	0.3150
exposed	0	1	-0.2959	0.2053	2.0772	0.1495
age		1	-0.0689	0.00285	584.3494	<.0001
pkyears		1	-0.00003	4.378E-6	38.6747	<.0001
bmi		1	-0.0853	0.00584	213.2110	<.0001
pathway		1	-0.0826	0.0143	33.3800	<.0001
age*exposed	0	1	0.00605	0.00276	4.8096	0.0283
pathway*exposed	0	1	0.0449	0.0140	10.2657	0.0014
bmi*subsex	1	1	-0.0221	0.00577	14.6026	0.0001

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
pkyears	1.000	1.000	1.000

Association of Predicted Probabilities and Observed Responses

Percent Concordant	83.4	Somers' D	0.670
Percent Discordant	16.4	Gamma	0.672
Percent Tied	0.2	Tau-a	0.227
Pairs	8871588	c	0.835

Partition for the Hosmer and Lemeshow Test

		FinalStatus = 0		FinalStatus = 1	
Group	Total	Observed	Expected	Observed	Expected
1	724	237	223.61	487	500.39
2	725	385	394.25	340	330.75
3	724	470	489.01	254	234.99
4	725	551	554.91	174	170.09
5	723	593	602.28	130	120.72
6	727	646	639.91	81	87.09
7	723	675	665.13	48	57.87
8	724	705	687.19	19	36.81
9	724	711	705.60	13	18.40
10	720	703	713.91	17	6.09

Hosmer and Lemeshow Goodness-of-Fit Test

Chi-Square	DF	Pr > ChiSq
37.6343	8	<.0001

The LOGISTIC Procedure

Model Information

Data Set	WORK.RESULTS
Response Variable	FinalStatus
Number of Response Levels	2
Number of Observations	7239
Link Function	Logit
Optimization Technique	Fisher's scoring

Response Profile

Ordered Value	Final Status	Total Frequency
1	0	5676
2	1	1563

NOTE: 68 observations were deleted due to missing values for the response or explanatory variables.

Stepwise Selection Procedure

Class Level Information

Class	Value	Design Variables 1
subsex	1	1
	2	-1
exposed	0	1
	1	-1

Step 0. Intercept entered:

Model Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

Residual Chi-Square Test

Chi-Square	DF	Pr > ChiSq
1715.9649	15	<.0001

Step 1. Effect age entered:

The LOGISTIC Procedure

Model Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	7554.989	6392.430
SC	7561.876	6406.205
-2 Log L	7552.989	6388.430

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	1164.5589	1	<.0001
Score	1038.1541	1	<.0001
Wald	871.6071	1	<.0001

Residual Chi-Square Test

Chi-Square	DF	Pr > ChiSq
732.9395	14	<.0001

Step 2. Effect subsex entered:

Model Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	7554.989	6110.752
SC	7561.876	6131.414
-2 Log L	7552.989	6104.752

The LOGISTIC Procedure

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	1448.2371	2	<.0001
Score	1271.0902	2	<.0001
Wald	1021.1400	2	<.0001

Residual Chi-Square Test

Chi-Square	DF	Pr > ChiSq
454.8809	13	<.0001

Step 3. Effect bmi entered:

Model Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	7554.989	5906.193
SC	7561.876	5933.742
-2 Log L	7552.989	5898.193

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	1654.7960	3	<.0001
Score	1373.9488	3	<.0001
Wald	1078.6536	3	<.0001

Residual Chi-Square Test

Chi-Square	DF	Pr > ChiSq
250.2719	12	<.0001

Step 4. Effect exposed entered:

The LOGISTIC Procedure

Model Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	7554.989	5767.473
SC	7561.876	5801.909
-2 Log L	7552.989	5757.473

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	1795.5158	4	<.0001
Score	1481.5831	4	<.0001
Wald	1131.1600	4	<.0001

Residual Chi-Square Test

Chi-Square	DF	Pr > ChiSq
100.3611	11	<.0001

Step 5. Effect pkyears entered:

Model Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	7554.989	5729.439
SC	7561.876	5770.763
-2 Log L	7552.989	5717.439

The LOGISTIC Procedure

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	1835.5500	5	<.0001
Score	1538.5582	5	<.0001
Wald	1155.0797	5	<.0001

Residual Chi-Square Test

Chi-Square	DF	Pr > ChiSq
58.7688	10	<.0001

Step 6. Effect pathway entered:

Model Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	7554.989	5703.405
SC	7561.876	5751.615
-2 Log L	7552.989	5689.405

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	1863.5845	6	<.0001
Score	1542.3404	6	<.0001
Wald	1150.9579	6	<.0001

Residual Chi-Square Test

Chi-Square	DF	Pr > ChiSq
31.3837	9	0.0003

Step 7. Effect bmi*subsex entered:

The LOGISTIC Procedure

Model Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	7554.989	5691.006
SC	7561.876	5746.103
-2 Log L	7552.989	5675.006

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	1877.9836	7	<.0001
Score	1586.3152	7	<.0001
Wald	1162.4126	7	<.0001

Residual Chi-Square Test

Chi-Square	DF	Pr > ChiSq
17.0129	8	0.0300

Step 8. Effect pathway*exposed entered:

Model Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	7554.989	5685.129
SC	7561.876	5747.114
-2 Log L	7552.989	5667.129

The LOGISTIC Procedure

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	1885.8598	8	<.0001
Score	1608.1602	8	<.0001
Wald	1167.2206	8	<.0001

Residual Chi-Square Test

Chi-Square	DF	Pr > ChiSq
9.2400	7	0.2359

Step 9. Effect age*exposed entered:

Model Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	7554.989	5682.239
SC	7561.876	5751.112
-2 Log L	7552.989	5662.239

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	1890.7497	9	<.0001
Score	1691.9826	9	<.0001
Wald	1181.3064	9	<.0001

Residual Chi-Square Test

Chi-Square	DF	Pr > ChiSq
4.3537	6	0.6289

NOTE: No (additional) effects met the 0.05 significance level for entry into the model.

The LOGISTIC Procedure

Summary of Stepwise Selection

Step	Effect Entered	Effect Removed	DF	Number In	Score Chi-Square	Wald Chi-Square	Pr > ChiSq
1	age		1	1	1038.1541	.	<.0001
2	subsex		1	2	278.3413	.	<.0001
3	bmi		1	3	217.5877	.	<.0001
4	exposed		1	4	144.8344	.	<.0001
5	pkyears		1	5	40.4217	.	<.0001
6	pathway		1	6	28.0833	.	<.0001
7	bmi*subsex		1	7	14.3138	.	0.0002
8	pathway*exposed		1	8	7.8455	.	0.0051
9	age*exposed		1	9	4.8187	.	0.0282

Type III Analysis of Effects

Effect	DF	Wald Chi-Square	Pr > ChiSq
subsex	1	1.0096	0.3150
exposed	1	2.0772	0.1495
age	1	584.3494	<.0001
pkyears	1	38.6747	<.0001
bmi	1	213.2110	<.0001
pathway	1	33.3800	<.0001
age*exposed	1	4.8096	0.0283
pathway*exposed	1	10.2657	0.0014
bmi*subsex	1	14.6026	0.0001

Analysis of Maximum Likelihood Estimates

Parameter		DF	Estimate	Standard Error	Chi-Square	Pr > ChiSq
Intercept		1	8.2344	0.2789	871.9122	<.0001
subsex	1	1	0.1763	0.1754	1.0096	0.3150
exposed	0	1	-0.2959	0.2053	2.0772	0.1495
age		1	-0.0689	0.00285	584.3494	<.0001
pkyears		1	-0.00003	4.378E-6	38.6747	<.0001
bmi		1	-0.0853	0.00584	213.2110	<.0001
pathway		1	-0.0826	0.0143	33.3800	<.0001
age*exposed	0	1	0.00605	0.00276	4.8096	0.0283
pathway*exposed	0	1	0.0449	0.0140	10.2657	0.0014
bmi*subsex	1	1	-0.0221	0.00577	14.6026	0.0001

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
pkyears	1.000	1.000	1.000

The LOGISTIC Procedure

Association of Predicted Probabilities and Observed Responses

Percent Concordant	83.4	Somers' D	0.670
Percent Discordant	16.4	Gamma	0.672
Percent Tied	0.2	Tau-a	0.227
Pairs	8871588	c	0.835

Obs	_LINK_	_TYPE_	_STATUS_	_NAME_	Intercept	subsex1	exposed0	subsexlexposed0	age	pkyears	bmi	pathway
1	LOGIT	PARMS	0 Converged	FinalStatus	8.23443	0.17625	-0.29588	.	-0.068912	-.000027224	-0.085257	-0.082596

Obs	subsexlage	exposed0age	subsexlpkyears	exposed0pkyears	subsexlpathway	exposed0pathway	subsexlbmi	exposed0bmi	_LNLIKE_
1	.	.006054443	.	.	.	0.044889	-0.022058	.	-2831.12